

ST. BARTHOLOMEW'S HOSPITAL



THE
MOZELLE SASSOON
HIGH VOLTAGE X-RAY THERAPY
DEPARTMENT

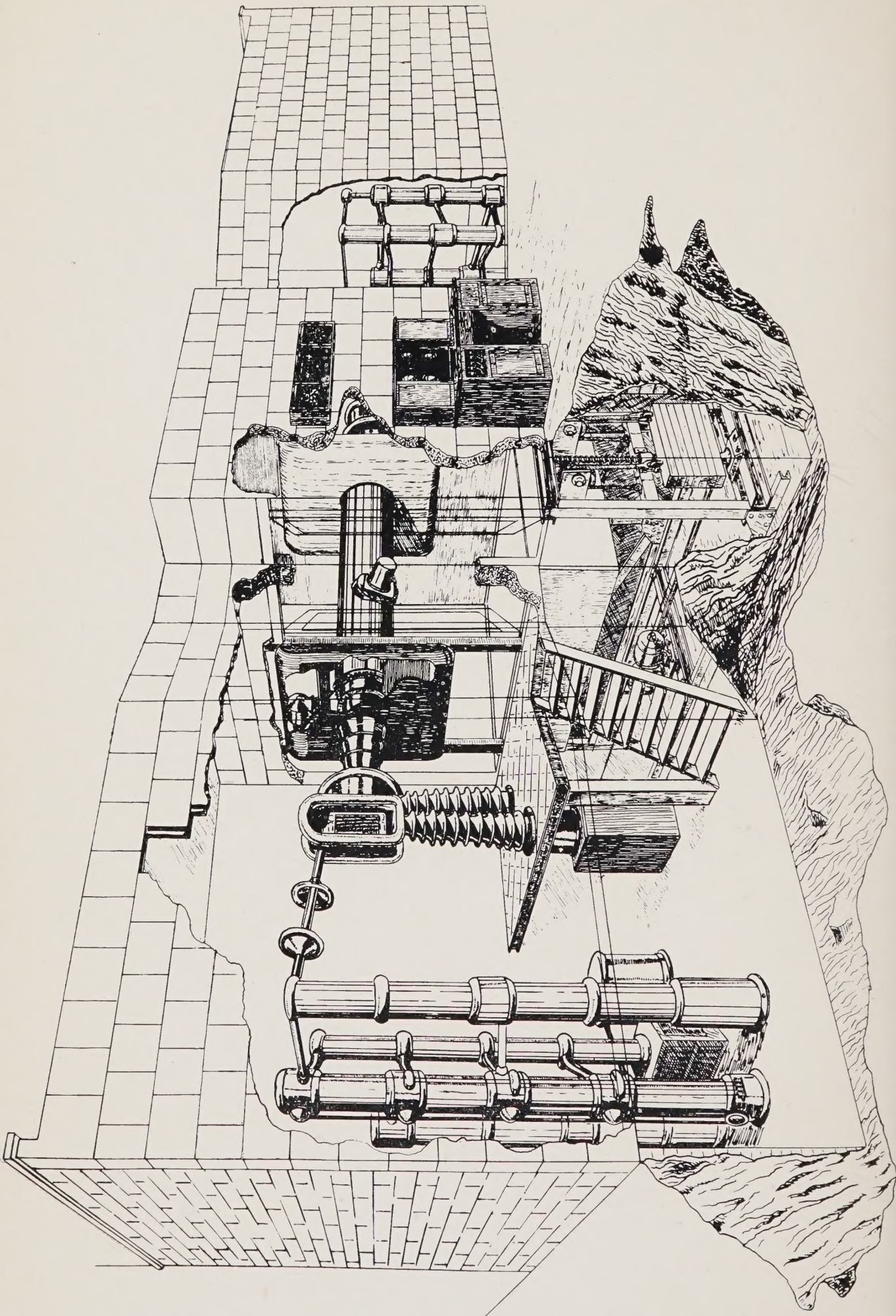


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ST. BARTHOLOMEW'S HOSPITAL
CANCER DEPARTMENT

THE MOZELLE SASSOON
HIGH VOLTAGE X-RAY
THERAPY DEPARTMENT



PERSPECTIVE OF APPARATUS

THE DEVELOPMENT OF RADIATION THERAPY AT ST. BARTHOLOMEW'S HOSPITAL

A new epoch in the treatment of cancer at St. Bartholomew's Hospital may be said to have commenced in the year 1919, with the formation of a Radium Committee. It is true that malignant disease has been continuously treated in the Hospital for many centuries, and that both radium and X-rays were in regular use for this purpose before the outbreak of the Great War. Organised and continuous investigation of the cancer problem, however, commenced with the formation of the Radium Committee, for the purpose of administering a quantity of radium loaned to the Hospital by the Medical Research Council. Although the primary object of the Committee was clinical investigation, yet from the very beginning the biological effects of radiation were also the subject of experimental research. A notable example of the latter type of investigation is the cinematographic study of the effects of radiation upon normal and malignant cells, carried out by the late Dr. Canti.

As a result of a visit of certain members of the Committee to Erlangen in 1921, an investigation into the value of Deep X-ray Therapy in the treatment of cancer was commenced in 1924. Meanwhile, the widening field of the Radium Committee's work led in 1923 to a change of name to the Radiotherapeutic Research Committee, which in 1928 became the Cancer Research Committee, and ultimately the executive committee of the Cancer Department, when this was formed in 1934. The present Cancer Department Committee is responsible for the co-ordination of all the cancer work, both clinical and experimental, in the Hospital and Medical College. The work of these Committees has been supported for many years by annual grants from the British Empire Cancer Campaign.

The results of the parallel investigations carried out with radium and X-rays convinced the Radiotherapeutic Research Committee in quite early days that an investigation into the value of X-rays generated at voltages higher than the customary maximum of 200,000 volts was

very desirable. A provisional site for a high voltage apparatus was allocated by the Governors in 1931, and plans to house such apparatus, when available, were drawn up. In 1933, through the far-seeing generosity of Mrs. Meyer Sassoon, it became possible to initiate the development of the desired high voltage apparatus, and to proceed with the detailed consideration of the necessary building. The final plans for the building, and the detailed specification of the apparatus, were agreed upon in April, 1934.



EXTERIOR OF DEPARTMENT

OBJECTS OF THE INSTALLATION

There are three main limitations to the effectiveness of present day technique in radiation therapy ; the difficulty of the delivery of an adequate dose of radiation to a tumour or site deep in the body, without damage to overlying structures ; the difficulty of giving this dose within a reasonably short exposure time ; and the narrow margin of safety, due to the small difference in radiosensitivity between normal and malignant tissues. The first of these can be overcome by means of a sufficiently penetrating radiation ; the second by the use of high intensities of radiation ; while differences in radiosensitivity depend in part upon the wave-length of the radiation employed.

The installation is designed to give a beam of X-rays of greater penetrative power, of higher intensity, and of shorter mean wave-length, than any so far employed in the treatment of cancer. Furthermore, since the apparatus may be operated at any voltage from 250,000 volts up to 1,000,000 volts, its range and flexibility will permit the choice of the optimum conditions of treatment which may be found applicable in different cases.

Thus the main object of the installation is the relief and cure of cancer by the application of the most recent developments in physical science to radiation therapy. Side by side with this work must proceed the investigation of the physical, chemical, and biological effects of X-rays generated at high voltages, and the therapeutic application of the results obtained.

THE BUILDING

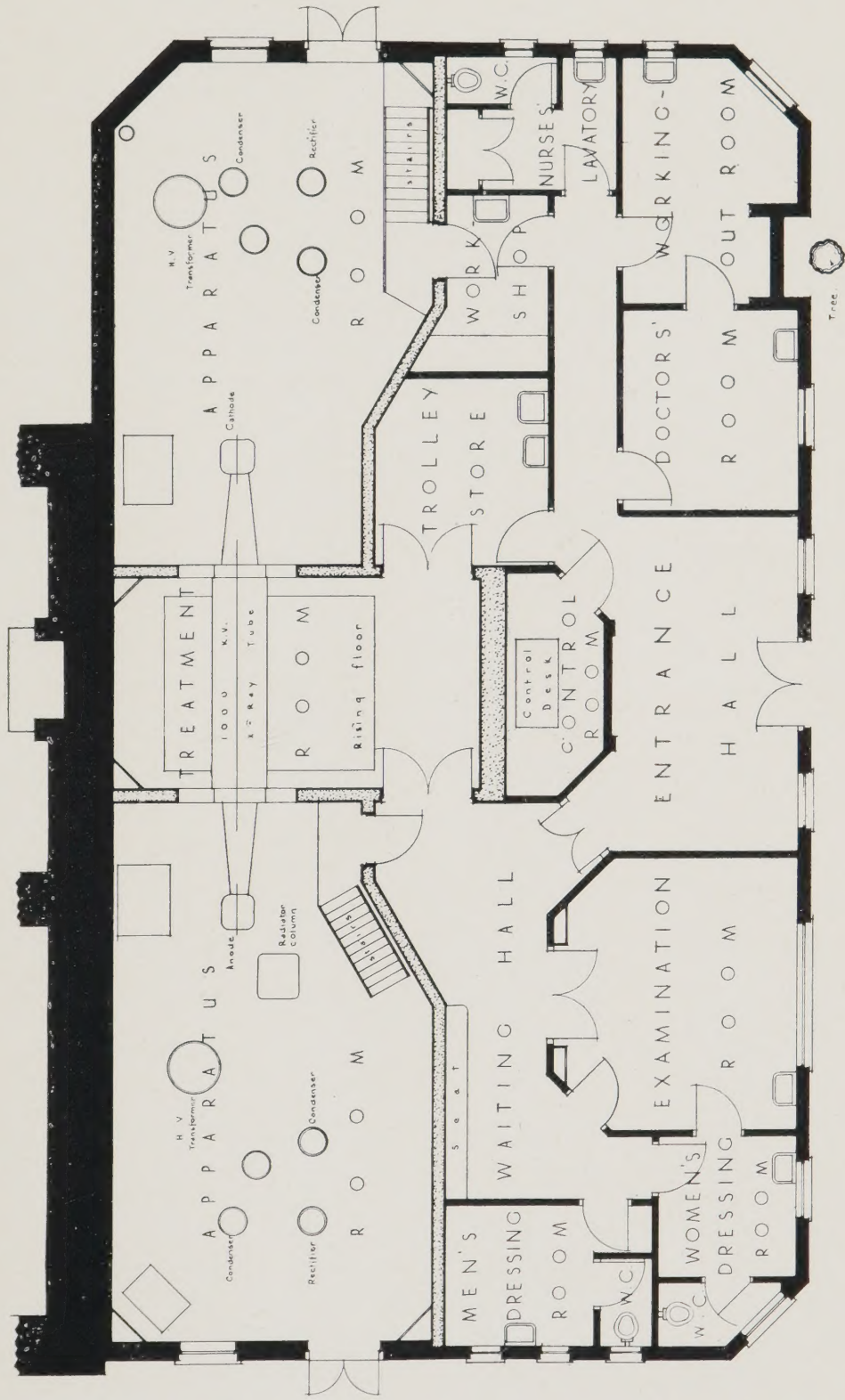
The building occupies a site, measuring 75 by 40 ft., at the East end of the Great Hall. The accommodation comprises a treatment room (containing the central portion of the X-ray tube) flanked by two generator rooms ; a control room, an examination room for patients with its adjacent dressing rooms, a treatment-planning room, a workshop, and rooms for the medical and nursing personnel.

In order to secure the necessary height of 22 ft. for the high voltage generators, the two generator rooms have been excavated to a depth of 8 ft. below the level of the rest of the department. A feature of the building is the radiation-proof wall, constructed of interlocking blocks of barium concrete, which separates the treatment and generator rooms from the administrative section.

Special attention has been given to the heating and ventilation of the building, both to secure the comfort of the patients and the insulation of the high voltage apparatus. This has necessitated the provision of an air-conditioning plant, to supply ten changes of air an hour in the treatment room, and five changes in the generator rooms.

The building was erected by the Hospital Office of Works, and the work has been carried out in such a way as to allow the incorporation of its more important components in a Radiological Institute, when funds for this larger scheme become available.

THE MOZELLE SASSOON HIGH VOLTAGE X-RAY THERAPY DEPARTMENT



BAR IUM CONCRETE WALLS SHOWN THUS

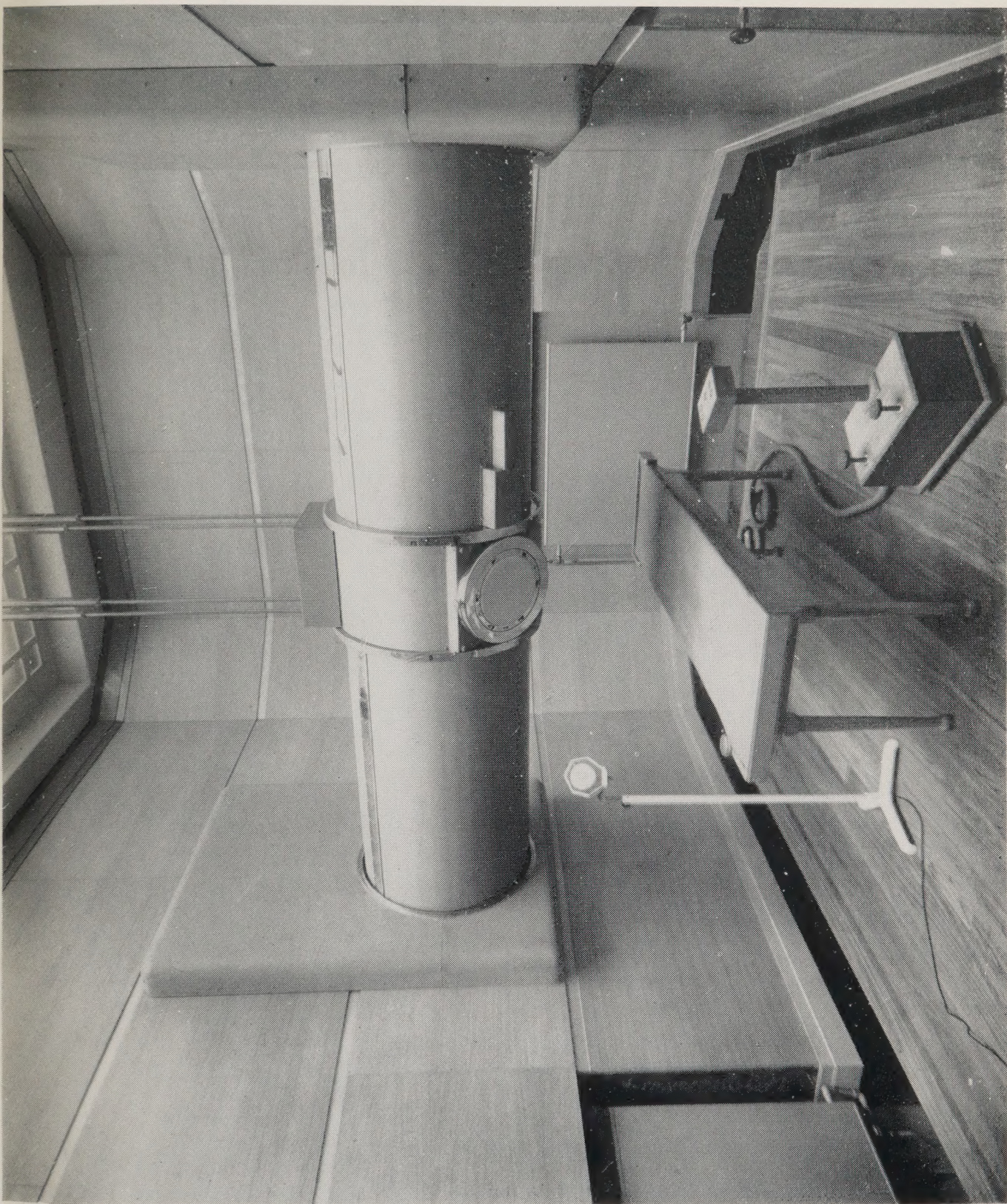
H EDMUND MATHEWS F.R.I.B.A.
A R C H I T E C T

PLAN OF THE BUILDING

THE X-RAY TUBE

The X-ray tube is the dominant feature of the Department, and embodies many noteworthy details, both of design and construction. It is thirty feet long, and weighs ten tons. It consists essentially of an inner continuously-evacuated steel tube containing the filament and target. This tube is supported at each end by a porcelain insulator, and extends horizontally from one generator room to the other across the treatment room. The portion within the treatment room, that is, the central twelve feet, is surrounded by a protective sheath, consisting of a six-inch layer of "close-packed" lead shot, enclosed between two coaxial steel cylinders. An aperture in this sheath allows the transmission of the X-ray beam. The protective sheath, in its turn, is surrounded by a steel cylinder, which carries the filters, diaphragms, and applicators for defining the X-ray beam. The protective sheath and applicator cylinder can be rotated independently of each other. In this way it is possible to direct the beam of X-rays at will, either through the applicator towards the patient, or into an absorbing lead saddle, six inches thick, suspended immediately above the tube. Thus, the portion of the X-ray tube within the treatment room is both shock-proof and ray-proof.

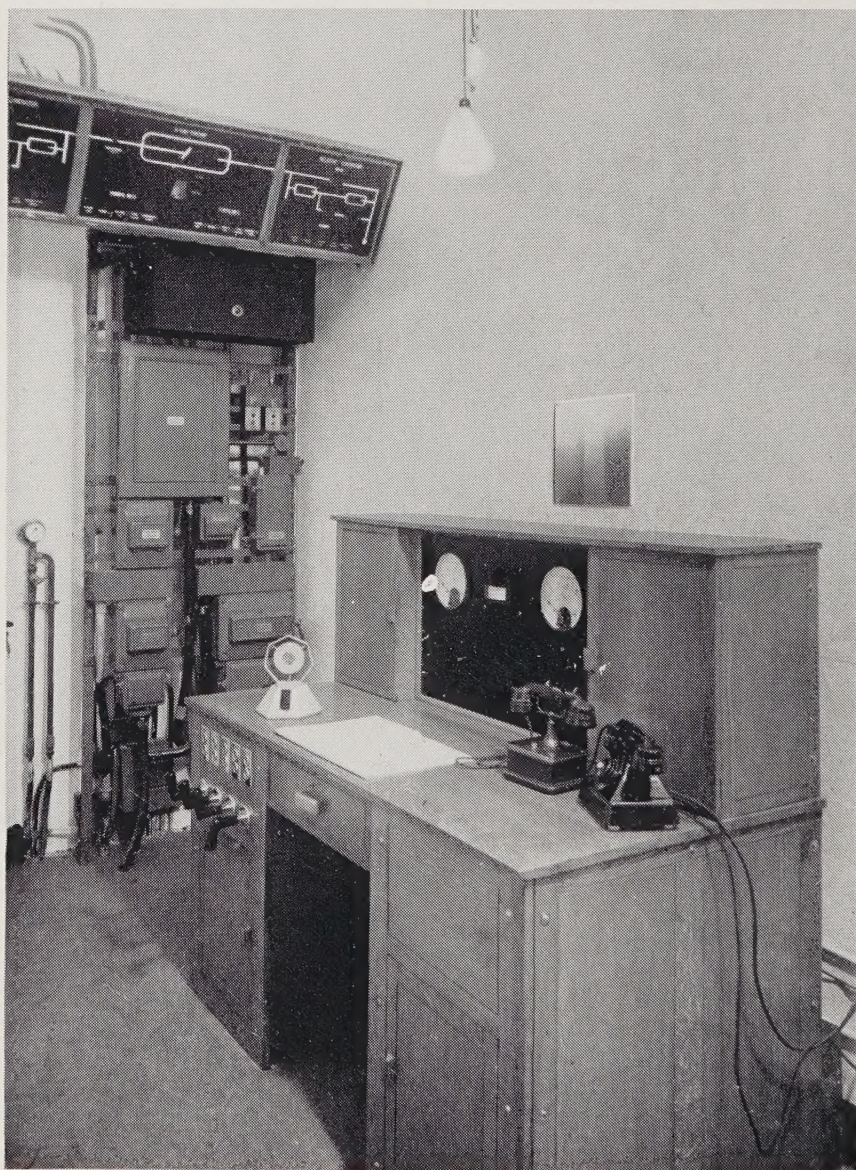
As the X-ray tube is fixed, the floor of the treatment room has been made movable, so that the position of the patient relative to the tube may be adjusted as desired.



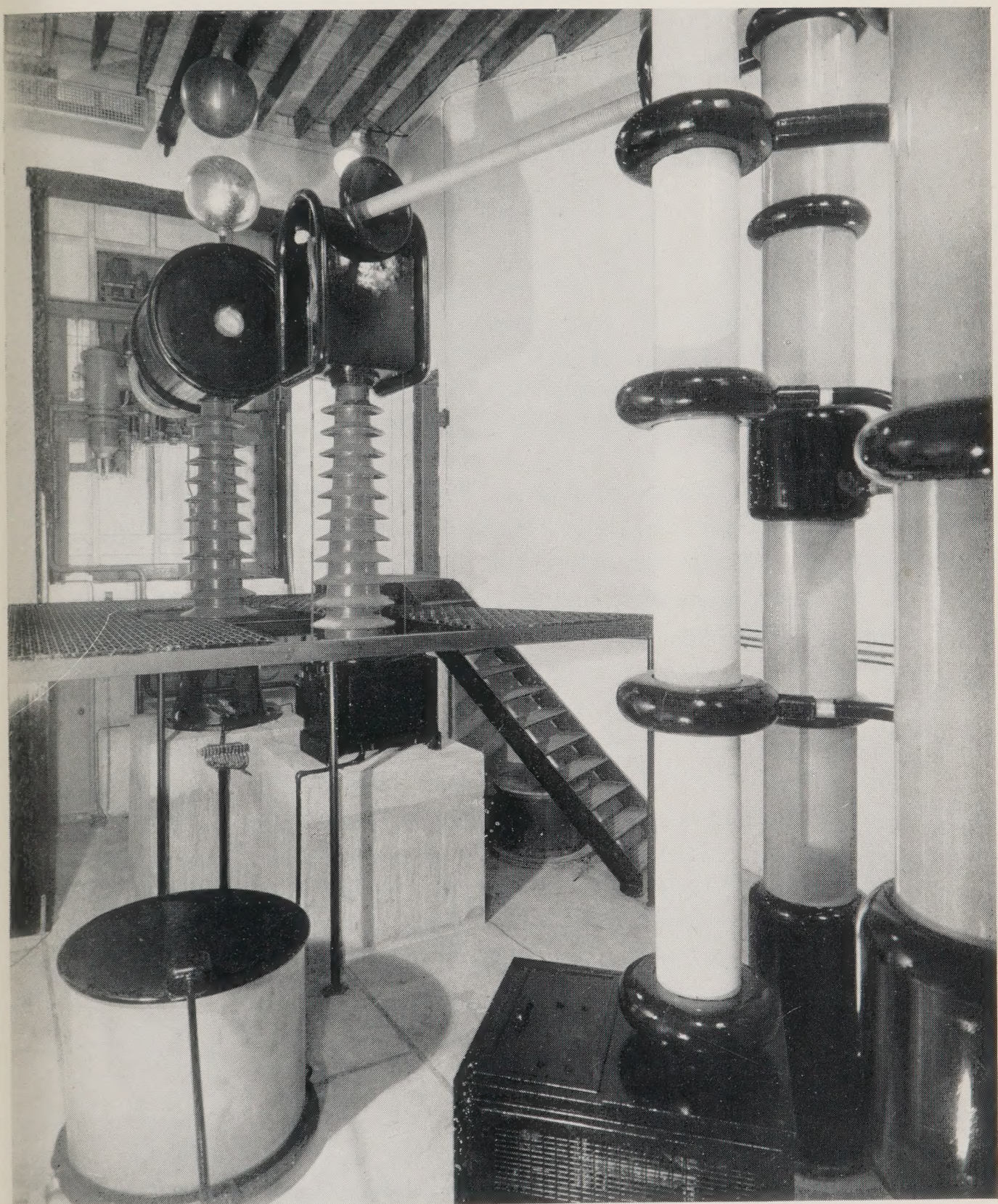
THE TREATMENT ROOM

THE GENERATORS

The generating equipment comprises two generators, one designed to give a positive potential of 600,000 volts, and the other a negative potential of the same value. The current for each generator is fed from the 400 volt A.C. mains into a transformer from which a current at 150,000 volts can be drawn. By means of a modified Greinacher circuit, embodying columns of continuously-evacuated thermionic valves and oil-immersed condensers, a rectified current at a constant potential of 600,000 volts may be obtained. Thus by using both generators, a constant potential of over one million volts may be applied to the X-ray tube. At this voltage, the tube is designed to carry a current of five milliamperes.



THE CONTROL ROOM



THE POSITIVE GENERATOR ROOM

CONTROL

The direction of all operations necessary for the treatment of the patient is carried out from the Control Room. These operations include the energising of the various components of each generator, and the control of the X-ray tube itself. The room contains the control desk, the main switches and fuse-boxes, and the diagrammatic indicator. On the control desk are mounted the recording instruments, such as voltmeters, ammeters, and dosimeter, and the push-button switches for operating the apparatus. By means of a series of automatic relays (housed in a cubicle in each generator room), each switch initiates a sequence of events. These sequences can be followed by the lighting-up of the appropriate lamps in the diagrammatic indicator.

Inter-communication between the control room and the treatment room is maintained by a two-way microphone and loud-speaker installation. The treatment room can also be observed from the control room by a novel periscopic system of eight concave mirrors. This was designed by Mr. T. Smith, F.R.S., to whom special thanks are due for his unique contribution to the Department.

PROTECTION

The production of such intense beams of highly penetrating radiation, capable of causing profound physiological effects, has necessitated the development of adequate protective measures, just as the use of very high tension apparatus has required the provision of safety devices.

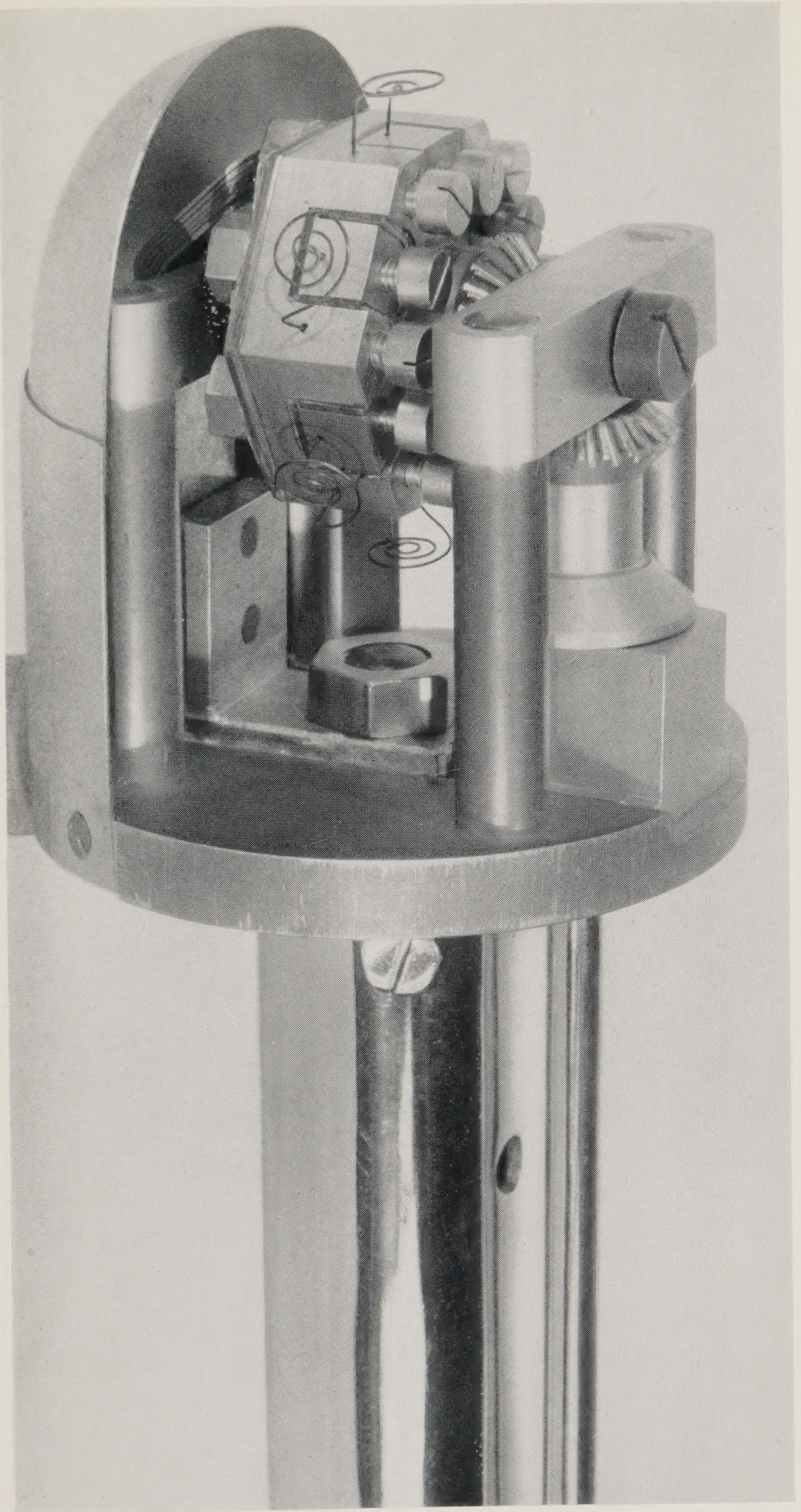
Mention has already been made of the six-inch lead sheath incorporated in the X-ray tube, and the protective wall of barium concrete between the source of the radiation and the operating personnel. The doors in this wall are constructed of heavy steel plates, and so designed as to prevent radiation leakage. The west wall of the Department abuts on the Great Hall, and the 4 ft. 6 in. thickness of the masonry here renders it ray-proof. Lead baffles have been so disposed along the axis of the X-ray tube as to eliminate radiation risk through the side walls of the Department.

Electrical interlocks on the doors and X-ray tube render the apparatus absolutely safe, by eliminating both the risk of electric shocks, and of accidental exposure to radiation.

The Treasurer and Governors wish to place on record their profound gratitude to Mrs. Meyer Sassoon, for presenting this Department to the Hospital, and for her continued interest in its progress.

They wish also to express their sincere thanks to the Sir Halley Stewart Trust, which has founded a Fellowship for a whole time worker in the Department ; and to the British Empire Cancer Campaign, which has for many years made an annual grant in support of the investigations directed by the Cancer Department Committee.

It is their confident hope that the Mozelle Sassoon High Voltage X-ray Therapy Department will make a worthy contribution both to the progress of knowledge and to the relief of suffering.



THE CATHODE, SHOWING FILAMENT-CHANGING
MECHANISM

ACKNOWLEDGMENTS

The X-ray tube and the generating equipment, together with the necessary controls, automatic relays and safety interlocks were designed and installed by Messrs. Metropolitan-Vickers Electrical Company, Ltd. This Company also manufactured the barium concrete blocks, and carried out the aluminising of the concave mirrors.

The movable floor was manufactured and erected by Messrs. Wadsworths, Ltd.

The periscopic concave mirrors were manufactured by Messrs. The United Kingdom Optical Company, Ltd.

The Treatment Couch was supplied by Messrs. The Genito-Urinary Manufacturing Company, Ltd.

The Treasurer and Governors acknowledge their indebtedness to the Directors of the above concerns, who placed the knowledge and experience of their technical advisers at their disposal.

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